FAA Engine Titanium Consortium

The FAA established the Engine Titanium Consortium (ETC) in 1993 to respond to recommendations made by the FAA Titanium Rotating Components Review Team (TRCRT) for improvements in inspection of engine rotating components.

The ETC was established with the objective of providing the FAA and engine manufacturers with reliable and cost-effective new methods and/or improvements in mature methods for detecting cracks, inclusions, and imperfections in titanium material and components. The ETC consists of a team of researchers from academia and industry — Iowa State University, AlliedSignal Propulsion Engines-Garrett, General Electric Aircraft Engines, and Pratt & Whitney. Major advancements are being made in the industry's ability to inspect critical rotating components both in production and in-service.

The ETC program was formulated with two distinct phases. In Phase I the ETC addressed the high-priority specific recommendations of the 1990 TRCRT report. Phase I, completed in 1998, was a 4-year effort focused on developing an understanding of the fundamental material properties of titanium and hard alpha, including their response properties to ultrasonic interrogation, developing billet inspection technology, developing tools for the detection of fatigue cracks typical of those that might emanate from hard alpha inclusions, and developing and applying tools to assess the reliability of inspection of rare defects. Shown above is a portable scanner that has been developed for use in airline overhaul and maintenance shops. The portable scanner consists of a generic mechanical scanning system with application specific tooling for probe positioning and manipulation. Adapter plates are used to mate the mechanical scanning system to a variety of engine disks by using the bolt hole patterns to align the system to specific disks.

Major ramifications of the Phase I effort are already evident in the aviation community.

An enhanced ultrasonic technique has been developed and implemented to detect defects in the titanium billet material used to manufacture engine rotating components. The system has demonstrated a four-fold improvement in defect detection compared to the current inspection and recently detected a defect that was missed by the conventional inspection system. To date, three billet production locations have inspected over 5.5 million pounds of titanium billet using this advanced technique. The new inspection technique will decrease the possibility of engine failure due to undetected flaws and increase the

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reliability and efficiency of inspection procedures for engine critical components. An industrywide ultrasonic billet inspection specification based on the new technique has been developed and has been approved by the Society of Automotive Engineers (SAE) Committee K and the SAE Aerospace Council.

In July 1996, Hamilton Standard presented a new blade shank repair to representatives of the FAA. This new repair was made possible by eddy-current inspection technology developed by the ETC and expanded the dent repair limits while maintaining the design structural integrity of the blade. The new repair permitted the return to service of approximately 200 blades, which helped the operators meet the shank inspection deadline without grounding any aircraft. The FAA estimated that the cost of grounding the affected aircraft had the repair not been done properly and in a timely fashion was $15 million.

Phase II of the ETC Program will focus on leveraging the technologies and tools developed in Phase I for application to other critical materials and applications. Principally this involves development of nickel billet and titanium forging inspection systems, the further advancement of in-service inspection tools to address emerging needs, and the extension of reliability assessment methodologies to other applications including in-service eddy-current inspections.

Throughout Phase II, scheduled to begin in late 1998, the ETC will continue to coordinate and cooperate with organizations pursuing related efforts. These organizations include the Rotor Integrity Subcommittee (RISC), Jet Engine Titanium Quality Committee (JETQC), the Special Metals Processing Consortium (SMPC), and the Air Transport Association's Nondestructive Testing (ATA NDT) Network.

To find out more about the FAA Engine Titanium Consortium, contact:

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